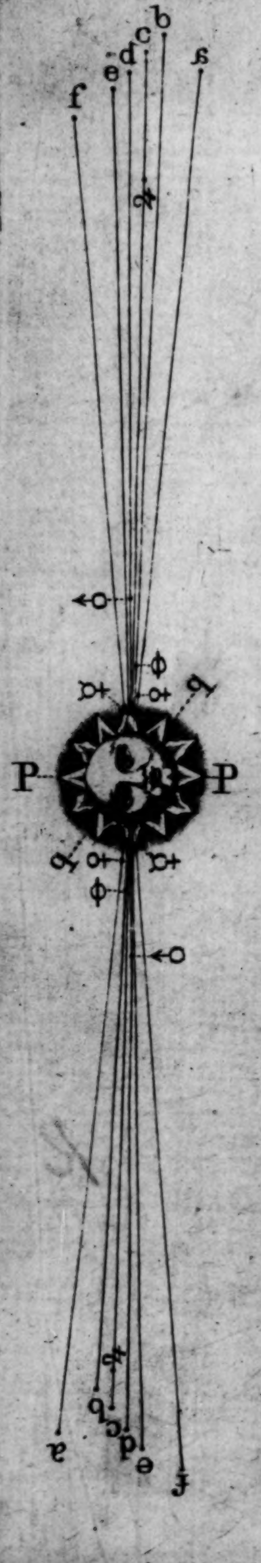
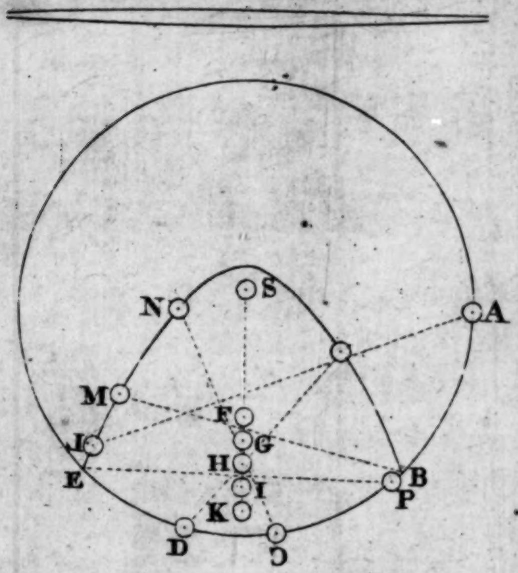
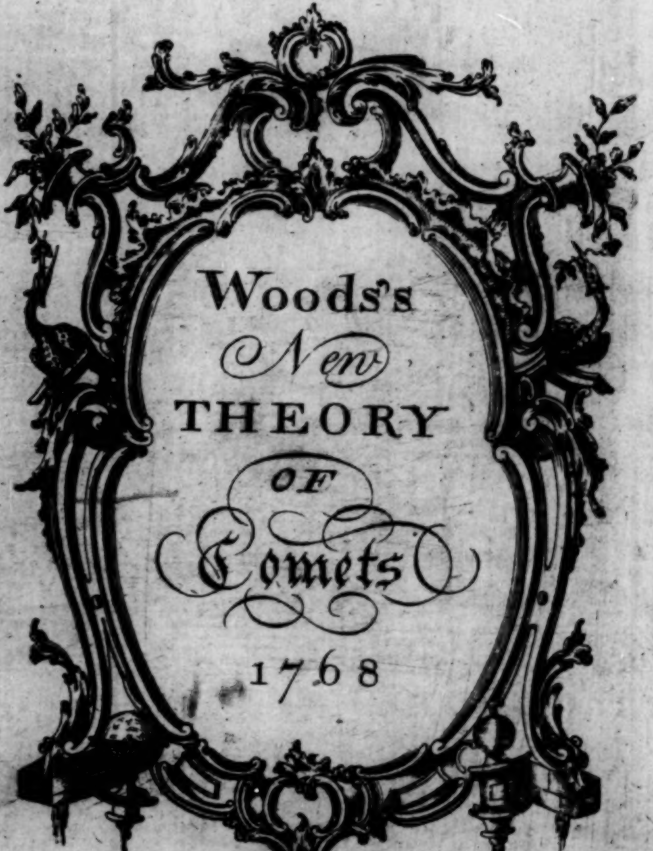
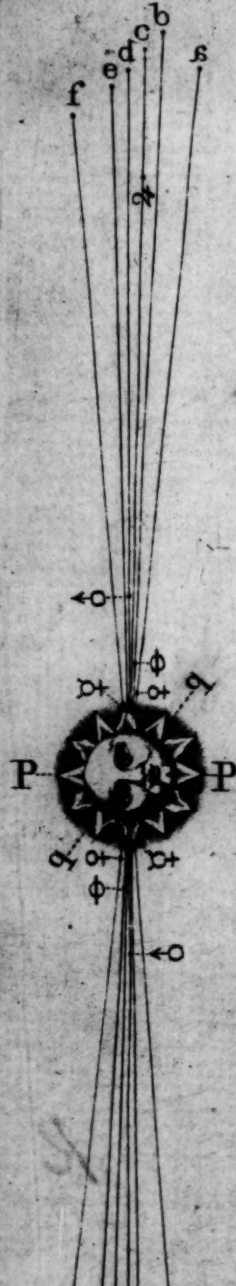


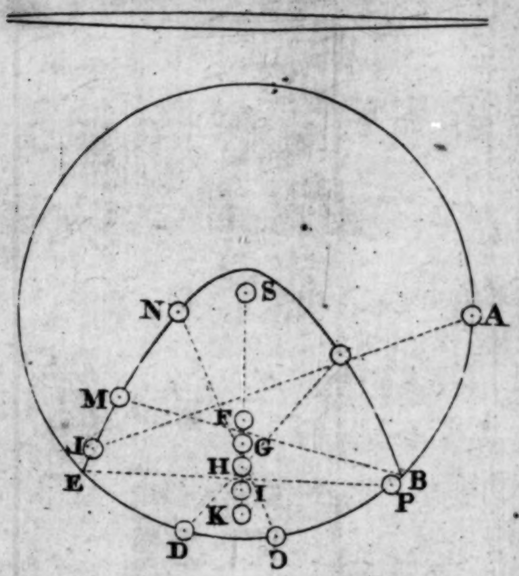




Woods's
New
THEORY
OF
Comets

1768





Woods's
New
THEORY
OF
Comets
1768

3326

A NEW
THEORY *of* COMETS;
(LAWS *of* MOTION,) &c.

PLAINLY SHEWING,

That they are not ſolid, compact, fixed and durable Bodies like thoſe of the Planets: But that they are Solar Meteors, or Exhalations of the ſame nature with our ſmoke, which flying to a certain diſtance from the Sun, thicken (or draw together) to ſuch a Maſs, that at laſt their own Gravity forces them back into its Blaze; where they no ſooner arrive but they take Fire, and are violently thrown off in right Lines thro' the Univerſe, till their own Flames have exhauſted their Subſtance.—The whole being freed from the abſurd Opinion, and Error of Sir *Iſaac Newton*, upon this Subject:

TO WHICH ARE ADDED,

Several Debates on the above, with the AUTHOR's Anſwer: Till at laſt this THEORY, now ſtands confirmed beyond all Contradiction.

By *MICHAEL WOODS*, F. R. S.

Thus ſaith the Lord, learn not the Way of the Heathen, and be not diſmayed at the Signs of Heaven, for the Heathen are diſmayed at them. Jer. x. 2.

LIVERPOOL:
Printed for the AUTHOR, by T. COWBURNE, in *Atherton-Street*, and
ſold by J. NOURSE, Bookſeller to His MAJESTY, in the *Strand*,
MDCCLXVIII.

BRITISH MUSEUM

TO

THE RIHGT HONOURABLE

THE

EARL OF *MORTON*,

PRESIDENT OF THE

ROYAL SOCIETY;

THIS NEW THEORY OF COMETS,

IS WITH ALL HUMILITY DEDICATED

BY

YOUR LORDSHIP's

MOST OBEDIENT AND

DEVOTED HUMBLE SERVANT,

LIVERPOOL,
May 1ſt. 1768.

MICHAEL WOODS.

BRITISH MUSEUM

ERRATA.

Page 7,	Line 20,	*for* of, *read* off.
9,	24,	*for* than, *read* then.
10,	10,	*read* ſame; *after* at the.
40,	14,	*for* Hevelus, *read* Hevelius.
43,	2,	*for* reſponder, *read* reſpondet.

A NEW

THEORY OF COMETS.

WHEN I ſeriouſly reflect on the terrible apprehenſions that the preſent doctrine of Comets leads our virtuoſo into, I cannot but think it will be doing great ſervice to mankind, to deliver them from imaginary fears of dreadful events that can never poſſibly happen.

WE all very well know of what ill conſequence the common ſtories of ugly bug-bears and hobgoblins are to children in general: ſcarce one pretty maſter or miſs in a hundred, that dares put a foot into the dark for fear of them; and yet, ridiculous as their fears are, I cannot think the gloomy imagination of Philoſophers, relating to the ſhocks of Comets, are a bit better grounded.

WHO can but laugh that hears old Mr. Facio talking of a mournful knowledge never poſſible to be obtained; or urging the ſeamen in *Greenwich Hoſ-*

pital to blind themſelves for a reward, while he tells them how, in his own time, the fiery Comets may have knocked holes thro' the planets orbit in ten thouſand places?—Or, who can but ſmile that ſees the ingenious Dr. Halley employed in deſcribing the orbit, and calculating the periodical revolution of a mere Ignis Fatuus, or Jack with a Lanthorn?

HOWEVER, amidſt all this laughter, one cannot but be really ſorry that men ſhould ſo careleſsly arraign the divine wiſdom, and charge the deity with folly; for what do they leſs, when they aſſert that, according to the preſent courſe of nature, the world cannot long continue, but the mighty globes which conſtitute it will daſh one another to pieces? What! Did not he, who gave being and motion to the ſeveral orbs, underſtand how to direct them in their ſeveral orbits, but that they muſt ſometime meet and by one fatal ſhock deſtroy themſelves, unleſs he ſhould pleaſe to alter the courſe of nature, that is, be at the expence of a miracle to prevent it?—O impious thought! unworthy of God! unbecoming of men!

YET a very little reflection on the works of nature, would ſoon have ſet gentlemen right in this particular, and by ſhewing them that ſuch dreadful accidents can never poſſibly happen, would have fully juſtified the wiſdom of the Almighty in the formation and managements of his works: for, do we not ſee that a certain exhalation ariſes from every fire? And muſt there not, then, be a prodigious exhalation from ſuch a burning globe as the ſun? And if this exhalation thickens or draws together in the ſolar regions, muſt it not at laſt, grow to ſuch a body, whoſe gravity ſhall force it back into thoſe dreadful flames from whence it proceeded?

Again, do we not ſee of what force the exploſion, even of gun-powder is, and with what violence it throws any thing off that comes near it? And can we think that the prodigious blaze of the ſun's body is leſs powerful?

Here then the ſurpriſing phœnomena of Comets are wholly accounted for;—They are ſolar meteors, or exhalations of the ſame nature with our ſmoke, which flying to a certain diſtance from the ſun, thicken (or draw together) to ſuch a maſs, that at laſt their own gravity forces them back into its blaze; when they no ſooner arrive but they take fire, and are violently thrown of in right lines thro' the univerſe, till their own flames have exhauſted their ſubſtance.——Let me now give my reaſons for this Theory. And firſt, the Comets going of from the ſun in right lines is a clear proof of this hypotheſis: 'tis true, our Aſtronomers ſay they move in elliptical orbits extremely eccentrical.—But this they are forced to ſay, to account for their own hypotheſis, and to bring them back to the ſun: otherwiſe, by all the obſervations that have ever yet been made, it appears plain that they deſcribe a right line,* in which they can never poſſibly return to the ſun any more, and therefore they muſt proceed from the ſun as before deſcribed.

Secondly, They appear to be balls of fire, and the fume they ſend forth into the heavens is a clear proof of it, as well as of their very great continual waſte; and conſequently they muſt proceed from the ſun as before aſſerted.

Thirdly, they fly from the ſun in all manner of directions, which muſt needs be the caſe in the above ſuppoſition, according to what part of the ſolar regions they happen to be fired of in, but has never yet, nor can be accounted for in any other way.

Fourthly, they have never been ſeen moving towards the ſun. It is next to impoſſible but this muſt ſometimes have happened, had the common hypotheſis been true, or had they ever returned to the ſun at all: Nay, there had then been as much reaſon for their near approach to the earth in their journey towards the ſun, as there is from it; and therefore as they have never been ſeen approaching to the ſun, it is very reaſonable to conclude, that they never do approach it in any orbit whatſoever, but are fired of from it as before mentioned.—Theſe reaſons taken together are, I think, a clear proof of my hypotheſis, give me leave therefore to obſerve that

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* The ingenious Mr. Ferguson ſays, the laſt Comet moved in a parabolic orbit retrograde to the planets: this will deſerve an anſwer when that gentleman (or any other) has proved that ſuch an orbit may poſſibly be. To my thinking a parabolic orbit is a ſtaring contradiction, and if ſo, that ſaying is retrograde to common ſenſe.

The true motion of the Comets is the beſt, and indeed an infallible demonſtration of the truth of the Copernican ſyſtem; for 'tis moſt evident, were not the ſun in the center, the Comets could not be always obſerved as moving directly from it: Nay, did it perform one annual revolution round the earth, it is very plain, the Comets might ſometimes appear as returning to it again. Thus were a Comet thrown off from the ſun with ſuch violence, as to meaſure the diameter of it's orbit, while it performed half its revolution, then if the Comet were thrown off from the ſun in Aries, in that direction it muſt meet again in Libra; and therefore, let the Comets have what motion they will, it is certain they could not always appear as moving from the ſun, unleſs the ſun remained immovable: No longer than let this plain truth be called in queſtion, but let all agree, that the ſun, as the king ſupreme, remains in the center of the world; and from thence imparts life, light, heat, and motion, to all the planets around him.

Again: The motion of the Comets is likewiſe a clear proof that the ſun is not at that immenſe diſtance from the earth, as has lately been imagined. Sir *Iſaac Newton* and Mr. *Huygens*, will needs have it, that the diſtance is at leaſt ten thouſand of the earth's diameter, or eighty millions of miles, and others ſince them have made it much more; ſo that Mr. *James Ferguſon*, F. R. S. ſays, if a cannon ball were ſhot off towards the ſun, and continued its progreſs thither, moving at the rate all the way, yet it would be twenty-five years before it could reach the ſun's body, for ought he knows, a great while longer.

Now, my Theory of Comets overthrows this amazing account of the ſun's diſtance; for, ſhould we allow the planets to move in their ſeveral orbits as ſwiftly as ſuppoſed, yet it is hardly poſſible to conceive how a ball of meer vapour ſhould be thrown off with ſuch violence from the ſun, as to paſs thro' the world ſo ſwift as the Comets muſt do according to this ſuppoſition: Or ſhould the Comet's ſwiftneſs be denied (as indeed it could not be) yet it would be as unconceivable how any ejected matter of ſo little denſity ſhould continue burning ſo many years as they then muſt do before they could paſs the earth's way.

But perhaps it will be ſaid, that Sir *Iſaac Newton*'s diſtances are a greater objection againſt my Theory of Comets, than my Theory is againſt his diſtances. —If my Theory be founded on clear reaſons, and his diſtances only uncertain conjectures, this is very ſtrange! * However, ſince the diſcovery of the true diſtances of planets from the ſun will fully anſwer this, and ſuch like objections; I will here ſhew how thoſe diſtances may be exactly obtained, by certain general laws as yet unknown to the world, but ſuch as, when known, will carry their own evidence along with them.

It has already been plainly diſcovered, That the ſquares of the periodical times of

The $\left\{\begin{array}{l}\text{Primary}\\ \text{Secundary}\end{array}\right\}$ Planets are one to another, as the cubes of their diſtances from the center of $\left\{\begin{array}{l}\text{the ſun}\\ \text{their primary}\end{array}\right\}$—This I call the IV. general law of motion, and add the following as a III. general law.—As the time of the $\left\{\begin{array}{l}\text{ſun's}\\ \text{planets}\end{array}\right\}$ Revolution

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* Sir *Iſaac Newton*'s diſtances, and all others that have appeared to this time, are founded on the ſun's parallax, which muſt be prodigiouſly uncertain, ſince 'tis impoſſible, in their way, to find out, how much the ſun's rays may be refracted in paſſing thro' the earth's atmoſphere: Some had the parallax to be 9, ſome 10, and ſome 11 ſeconds; yea, ſo great is the difference between them, that Mr. *Martin* will have it to be near 139 ſeconds: A clear proof, that none of them know any thing of the matter.

Revolution upon its axis is to the periodical time of the $\left\{\begin{matrix}\text{firſt planets}\\ \text{firſt ſatelles's}\end{matrix}\right\}$ Revolution in its orbit, ſo is the $\left\{\begin{matrix}\text{ſun's}\\ \text{planets}\end{matrix}\right\}$ ſemidiameter to the diſtance of its firſt $\left\{\begin{matrix}\text{planet}\\ \text{ſatelles}\end{matrix}\right\}$ from the ſurface of the $\left\{\begin{matrix}\text{ſun}\\ \text{planet}\end{matrix}\right\}$

† Thus as 9 hours, the time of Jupiter's revolution upon its axis, is to 42 hours the time of his firſt ſatelles's revolution round him, ſo is one ſemidiameter of Jupiter to $4\frac{6}{9}$ ſemidiameters well known to be the diſtance of Jupiter's firſt ſatelles from its ſurface. In this particular then this law of motion is right: Let us next try how it will anſwer with regard to Mercury and the ſun.

Mercury I find to be $84\frac{5}{10}$ ſemidiameters of the ſun, diſtant, from its ſurface, and its periodical revolution is performed in about 88 days: Say then, as 84, 5 ſemidiameters of the ſun are to 1 ſemidiameter, ſo are 88 days to 1 day and 1 hour; ‡ the time in which the ſun muſt turn round upon it's axis, according to this law of motion.

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† I ſhall prove that the fixt ſtars follow Saturn by the ſame law.

‡ It wants 22 ſeconds of an hour, which being a very trifle, I put down one hour for the ſake of a round number.

But here it will be objected, that aſtromers have diſcovered by the Solar Maculæ, that the ſun turns round upon its axis in 25 days, (if thoſe ſpots are really in its body, elſe not all) * and conſequently, this law does not hold good with regard to the ſun and Mercury.—I anſwer that, according to this law, the ſun muſt appear by thoſe ſpots, as if it turned round upon its axis in 25 days, tho' in a retrograde manner to its true motion: For we muſt ſuppoſe that theſe obſervations were taken when the ſun was in the meridian: (the propereſt time of taking them) Now if the ſun revolves upon its axis in 25 hours, it is evident that it muſt move 14. 24. in an hour; and conſequently, when viewed the ſecond day at noon, theſe ſpots will want 14, 24. of being where they were obſerved the day before; § and ſo the ſun will appear, as if it had moved 14. 24. the contrary way; and this 14. 24. multiplied into 25 days give 360, the degrees in a great circle. A ſurpriſing exactneſs! which plainly ſhews that at the end of this time the

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* They ſhould ſay, elſe they cannot tell whether it revolves upon its axis, or not; for it is moſt certain that the ſun may turn round upon its axis, whether it has ſpots, or not; tho' 'tis as certain that without ſpots its motion cannot that way be diſcovered.

§ Exactly they will want 14. 15. 26. (becauſe it wants 22 of an hour, as before mentioned) and ſo the ſun appears with the ſame face at the end of 25 days and 6 hours; but I keep to round numbers for plainneſs ſake, and I verily believe I ſun muſt appear with the ſame face, as it did when firſt obſerved; and ſo this, inſtead of being an objection againſt it, is a clear demonſtration that this law does hold good with regard to the ſun and Mercury, † and alſo accounts for the appearing retrograde motion of the ſun, which has ſo long puzzled aſtronomers.

From the ſun and Mercury, let us return home to our own earth and the moon: The moon performs its periodical revolution in 27 days 7 hours and 43 minutes, ſay then—As 1440 minutes, is to one ſemidiameter of the earth, ſo is 39343 minutes to 27 $\frac{32}{100}$ ſemidiameters of the earth; which muſt be the exact diſtance of the moon from the earth's ſurface, according to this law of motion.

But now methinks I perceive many of my readers to cry out, "Here your general law fails; for at this reckoning the moon's diameter will be but about 900 miles, which is hardly 1-eight part of the earth's: But every eclipſe of the moon convinces us that this is falſe; for the diameter of the earth's ſhadow at the moon is but litttle more than 3 of the moon's diameter's, which according to this account ſhould be above 6."—I anſwer that this law does certainly hold good with reſpect to the moon and the earth: And here I muſt put the objectors in mind, that, being creatures of the ærial kind, they forgot to reckon the height of the atmoſphere into the earth's ſemidiameter; whereas it is moſt plainly an eſſential part of it, as well as the land and water.

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† I am quite amazed!—How came the day to be divided in 24 hours from the beginning?—Was it not to adjuſt the earth's motion upon its axis to that of the ſun?—How far then did the Antediluvians exceed us in the knowledge of aſtronomy?—Us! who could not tell till now, that the ſun revolves upon its axis in 25 hours! Us! who thought it turne

All therefore that can be inferred from this remark on lunar eclipſes is,—That the height of the air is * equal to the ſemidiameter of the earth, as conſiſting of land and water. Thus is the general law of motion fully eſtabliſhed, and by it the moon's diſtance and magnitude may be as exactly determined as the length of the earth's ſemidiameter; all which I take to be as follows,

earth's diameter is	14800	miles
moon's diſtance is	209568	
moon's diameter is	1800	

The truth of this general law being thus eſtabliſhed, it plainly follows, that the motion of the planets upon their axis's, and in their orbits, is dependent upon the motion of the ſun upon its axis; and the motion of the ſatellites, in their orbits, is dependent on the motion of their primary planet upon its axis: And therefore the motion of the ſun upon its axis, muſt

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* This will be further cleared up hereaſter.

muſt be the firſt eſtabliſhed cauſe of all motions in this planetary ſyſtem. Now as all ſecundary motions ariſing from one firſt, and acting in perfect uniformity, muſt be uniform; it is very evident, that the motion of the planets upon their axis's, muſt be in proportion to their ſemidiameters; or (which is all one) as they receive their motion immediately from one cauſe, they muſt move all with one force.

HERE then is diſcovered a

II. General law of motion.—As the time of any one planet's revolution upon its axis, is to the length of its ſemidiameter; ſo are the times of all the reſt of the planet's revolutions upon their axis's, to the reſpective lengths of their ſemidiameters.—Thus as 24 hours, the time of the earth's revolution upon its axis, is to 7400 miles, the earth's ſemidiameter; ſo is 9 hours and 54 minutes the time of Jupiter's revolution upon its axis, to 3060 miles, the ſemidiameter of Jupiter: So that Jupiter's diameter is found, as nearly true as the earth, to be 6120 miles. Having thus found the diameter of Jupiter, its diſtance from the ſun will be diſcovered, by trigonometry, to be about 34,500,000 miles; ſo that by the IV general law, (already taken notice of,) the diſtances of all the primary planets are nearly as follows:

Mercury's

Mercury's	Diſtance is	2,600,000	Miles; ſo that
Venus's		4,800,000	
Earth's		6,600,000	
Mar's		10,000,000	
Jupiter's		34,500,000	
Saturn's		63,000,000	

Mercury's	Diameter is	185	Miles
Venus's		620	
Earth's		14,800	
Mar's		340	
Jupiter's		6,120	
Saturn's		5,050	

perhaps it will be ſaid, that the revolution of Mars and Venus upon their axis do not agree with their diameters here given; the former turning round in 24 h. 40 m. and the latter in 23 h. whereas if this were true, Mars ſhould complete its revolution in 33 m. and Venus in an hour.—I anſwer, that the time of the revolution of Mars and Venus upon their axis's does not ſeem to me to have yet been diſcovered: The times mentioned have only *M. Caſſini* for their voucher, who might be deceived; for as to Venus, *Mr. Huygens* [who often viewed it with a teleſcope 60 foot] ſays, he could ſee nothing like a ſpot in it; and I myſelf in 1766, have viewed it with a teleſcope 126 foot long, [which *Mr. Huygens* bequeathed at his laſt will to the Royal Society] and could ſee nothing like a ſpot in it; and how any man, without ſpots, could, by obſervation, determine the time any more than the axis of its daily rotation, is quite [I muſt own] beyond my comprehenſion. If then *M. Caſſini* did really ſee any ſpot, it was not in the body of Venus, and therefore nothing could be gathered from it.

Mars, indeed, has enough to determine its revolution by; but then thoſe who have viewed it obſerve, that they [many of them at leaſt] ſuddenly diſappear, and from thence they have concluded them to be clouds, &c. But, I ſay, this ſudden diſappearance was occaſioned by the ſwift rotation of the planet upon its axis, ſo that I muſt leave this matter to be more carefully examined into.

I have not been very nice in ſetting down theſe diſtances, and magnitudes of the planets; for as it is my preſent buſineſs to diſcover laws of calculation, and not to calculate, the neareſt round number are ſufficient: But, before I proceed further, give me leave to ſpeak a word or two, of the eccentricity of their orbits.

Our Aſtronomers ſay, that the planets move in elliptical orbits round the ſun placed in one of the focus's—Hereupon it may be aſked, Why is the ſun in one of the focus's? What muſt be in the other? Can you deſcribe an ellipſis on one focus? If not, how does the force of the ſun's motion cauſe the planets to deſcribe one? And how does one and the ſame motion cauſe every planet to deſcribe a different ellipſis?—As theſe difficulties have never yet been cleared up, the following account cannot but pleaſe the ingenious reader.

Dr. Hook, in his remarks on the ſolar maculæ, has obſerved, that the earth, in its orbit, cuts the plane of the ſun's equator in Dec. and has greateſt inclination to it in June.—And therefore, as the earth is very well known to be in its perihelion in Dec. and in its aphelion in June; and as it is moſt evident that the force of the ſun's motion muſt be greateſt in its equator, and from thence decreaſe gradually to its poles; nothing can be more plain, than that the attraction of the ſun is greateſt where the force of its motion is greateſt; and conſequently, the motion of the ſun upon its axis is THE FIRST CAUSE OF ATTRACTION, OR GRAVITY. Now as the force of the ſun's motion and attraction* is greateſt in its equator, it is evident, as any planet approaches that equator in its orbits, it muſt be brought proportionally nearer the ſun and carried proportionably ſwifter, ſo as to deſcribe Area's proportional to the times; and therefore, if a planet moves in an orbit exactly over the ſun's equator, or in any other line parallel thereto, it muſt move in a circle, the center of which will be the ſun: For, the ſun's action being the ſame in every part of its orbit, muſt always carry it about at the ſame rate, and at the ſame diſtance, and therefore the courſe it will deſcribe muſt be circular.

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* I ſhall expreſs theſe two hereafter by one term.—The ſun's action.

Again; if a planet moves in its orbit obliquely, or with any degrees of inclination to the ſun's equator; if the courſe it deſcribes be exactly over the ſun, [i. e. ſo as a line drawn from the oppoſite parts of its orbit will paſs directly through the ſun's center;] then, I ſay, it will move in an ellipſis, which will have the ſun in its center; and this ellipſis will be more, or leſs eccentric, as the motion of the planet in its orbit, is more or leſs oblique to the ſun's equator; its aphelion [for then it will have two in each periodical revolution] being in its neareſt approach to the ſun's poles, and its perihelions in the nodes or points, where it croſſes the ſun's equator: For the ſun's action upon it increaſing more and more, as the planet approaches its equator in its orbit, muſt neceſſarily carry it ſwifter, and bring it nearer its own body; and on the contrary, as it departs from the equator, the ſun's action upon it muſt decreaſe, and the planets move proportionably ſlower, and get further from its center.

Again; if a planet moves in its orbit obliquely, or with any degree of inclination to the ſun's equator; if the courſe it deſcribes be not exactly over the ſun, but that a line drawn from the oppoſite parts of its orbits will be more or leſs diſtant from the ſun's center, and it never reach in any part of its orbit to croſs the ſun's equator; then, I ſay, it will move in an elliptical orbit that will have the ſun in one of its focus's, its aphelion being at its neareſt approach to the ſun's pole, and its perihelion at its neareſt approach to the equator: For as the planet can approach the ſun's equator but once in its orbit, it is evident [from the reaſon before given] that when it does approach it, it muſt be in its perihelion, and conſequently the ſun muſt be in the focus of the ellipſis it deſcribes; yea, and its orbit muſt be far more eccentric, than if it paſs directly over the ſun with the ſame degrees of inclination, in as much as ſuch a motion admits of a greater increaſe and decreaſe of the ſun's action upon it.

Again; if a planet moves in its orbit obliquely, or with any degrees of inclination to the ſun's equator; if the courſe it deſcribes be not exactly over the ſun, but that a line drawn from the oppoſite parts of its orbit will be more or leſs diſtant from the ſun's center, but yet ſo that it will more or leſs paſs the ſun's equator in ſome parts of its orbit, then, I ſay, it muſt neceſſarily move in an elliptical orbit, that will have the ſun in a certain point of its tranverſe diameter, between the focus and center of the ellipſis, more or leſs diſtant from the former, in proportion to what it more or leſs paſſes the ſun's equatorial line: For, its perihelion muſt ever be in the nodes or points where it paſſes the line, and its aphelion at that pole which it approaches neareſt: Yet here it muſt be obſerved, that if the planet paſſes the ſun's equator but little in its orbit, the ſun will be as little diſtant from the focus; and conſequently, it may not be poſſible to diſtinguiſh its perihelions, ſo that they may well be taken for one, only it will be remarkable that the planet comes ſooner to it, and continues longer in it.

In one of theſe four ways every planet muſt move round the ſun, and, if aſtronomers are right in their calculations, it muſt be in the third: Indeed, as to Venus and the earth, I don't queſtion but they are right; for as their orbits have but very little inclination to the ſun's equator, they may move in that manner, and yet the ſun be very near the planetary center. It is evident from the figure before, that the ſun may be near the planetary center, and Mercury, tho' it has the greateſt inclination of all the planets, may not croſs its equator, by reaſon of the ſmallneſs of its orbit; yet the ſun may be much nearer that center, and neither the earth nor Venus croſs it: But if Mars, and eſpecially Jupiter and Saturn, in their large orbits, do not croſs the ſun's equator, it muſt be farther removed from that center than I think it can be: So that as to Mercury, I am in doubt; but as to Mars, Jupiter and Saturn, I verily believe they have the ſun in ſome point of the tranſverſe diameters of their elliptical orbits, between the focus and the center, as in the fourth caſe. If what I have ſaid be well conſidered, the irregularities in the moon's motion will be eaſily accounted for but whether the other four planets, eſpecially Jupiter and Saturn, do not croſs the ſun's equator; and conſequently, whether they have not the ſun in ſome point of the tranſverſe diameter of their elliptical orbits between the focus and the center, as in the fourth caſe, I muſt leave to future obſervations to determine: But be this as it will, from what I have ſaid it appears plain, that the planets moving round the ſun obliquely to the ſun's equator, and not exactly over its body, is the true cauſe of their orbits being ſuch as deſcribed Q. E. J. Nor does it only demonſtrate this, but it is a clear proof that the Comets do not move in elliptical orbits round the ſun, and that there can be no ſuch as a retrograde motion. Before I take my leave of this point, I can't forbear remarking, that as the earth, and the reſt of the planets moving directly over the ſun, with ſome degrees of inclination, is certainly moſt perfect; and would make the planets, and eſpecially the earth's and Venus's orbits, ſo very near a circle as to be ſcarce perceivable; and as they would all then, in a regular manner, and in equal time, proceed from the equinoctial to each tropic: (& vice verſa) I ſay, when I reflect upon this, and at the ſame time conſider, that the infinitely wiſe God created all things moſt perfectly; I can't in the leaſt doubt, but that all the planets moved in this moſt perfect form at the beginning; and therefore, that their motion is now otherwiſe, muſt be the conſequence of the fall of man, and take place at the flood: It was then that the moſt High, by removing the ſun out of the planetary center, in a natural way, changed the orbits and centers, of all the planets, ſo that not only the earth, but all the reſt of the heavenly bodies, were in ſome ſort ſufferers at that time: 'Twas from hence, and from the Almighty's pulling up the flood-gates of Heaven, that that terrible inundation proceeded which then overwhelmed the world: Such a change as this happening, it muſt be ſome time before either planetary orbits, or centers, could be ſettled; and till they were ſettled, there muſt be ſurpriſing agitations, and convulſive throws; the earth tottering to and fro, the waters aſcending, and men's hearts failing them, for fear of thoſe things that were coming to paſs; and indeed,

Let Q Q repreſent the ſun's equator, P P the ſun's poles, a a the inclination of Venus's orbit, b b the inclination of the earth's orbit, c c the inclination of Jupiter's orbit, d d the inclination of Mars's orbit, e e the inclination of Saturn's orbit, f f the inclination of Mercury's orbit, and the ſpots on theſe lines the diſtance of each planet from the ſun: Here it is evident that the inclination of the orbits of Mercury, Saturn and Mars, to the ſun's equator, is much greater than that of Jupiter, the earth and Venus; and accordingly their orbits are known to be more eccentrical.—If Aſtronomers, inſtead of taking the inclination of the planets orbits to that of the earth, would be at the pains of finding the inclination of the earth's, and all the reſt of the planets orbits, to the ſun's equator, and the ſun's diſtance from the planetary center; the eccentricity of their orbits, &c. might be much better determined than it is at preſent.

deed, ſuch dreadful diſorder muſt have ended in the total ruin of creation, had not he who commanded it ſaid,—"*Hither ſhalt thou go but no further.*"—'Tis from hence that I date the preſent irregular motion of the planets, of which the irregular motion of their ſatellites is a neceſſary conſequence; ſo true, in this reſpect, is that ſaying of an inſpired writer.—"*The whole creation groans, and travails in pain until now.*"

But to return to my ſubject; Mercury's diſtance being 2,600,000 miles from the ſun, and that being 85½ of the ſun's ſemidiameters, it is very plain, that the ſun's apparent diameter muſt be about 61000 miles: Say then, as 24 hours, the time of the earth's daily revolution, is to 14800 miles, its diameter; ſo is 25 hours, the time of the ſun's revolution upon its axis, to 15400 miles, which would be the ſun's diameter, if it moved with the ſame force with the planets; ſeeing therefore that it moves a diameter of 61000 miles in the ſame time, it is evident that it muſt move with four times the force that the planets do, ſo that this is diſcovered to be the I. general law of motion.—The ſun as the firſt eſtabliſhed cauſe of all motion in this planetary ſyſtem, turns upon its axis (at leaſt ſenſibly*) with four times the force that the planets do.

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* This will be explained hereaſter.

FROM what I have ſaid it appears plain, that all the planets, and their ſatellites are formed according to the moſt exact rules of Geometry: For as the diameter of Mercury is to that of Mars, ſo is the diameter of Mars to that of Venus; and as the diameter of Saturn is to that of Jupiter, ſo is the diameter of Jupiter to that of the earth, not including its atmoſphere.* And as there is this ſurpriſing harmony in the magnitudes of the planets, ſo there is the ſame in the inclination of their orbits, the mean planet, with regard to inclination, moving juſt in the midſt of the other that are proportional to it. Thus let Venus's orbit be the ſtandard, then will Mars's orbit have 5° inclination to it, and Mercury's 10°; ſo that it is evident that Mars's orbit, with regard to inclination, is juſt between Mercury's and Venus's. Again; let the earth's orbit be the ſtandard, then will Jupiter's orbit have 1°. 15, and Saturn 2° 30, ſo that Jupiter's orbit with regard to inclination, is juſt between Saturn's and the earth's. Wonderful harmony this! nor is it leſs remarkable, that the greateſt planet in proportion has leaſt inclination in its orbit, et vice verſa; and conſequently, there is a proportionality in the eccentricity of their orbits, the orbit of the leaſt planet being ſtill moſt eccentrical.

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* As the atmoſphere is not viſible to us ærial creatures, does not its excluſion in this proportion prove plainly, that the viſible world is peculiarly adapted to the contemplation of man, that he, more eſpecially, might therein behold the wiſdom and glory of God?——Is not this a clear proof of his primitive

Now as theſe noble proportions are a clear proof of the truth of thoſe laws from whence they derive their being; ſo if Aſtronomers had fallen upon them, they muſt from hence have diſcovered the true diſtances, and magnitudes of all the planets, even ſuppoſing the laws by which I have done it had remained in darkneſs: For as by ſeveral methods they could accurately compare the magnitudes of the ſun, and all the planets, [except the earth] one with another; they could not but ſee, in their own way, that Mercury, Mars and Venus, were proportional; and from thence they might have concluded, that Saturn, Jupiter and the earth, muſt be ſo too; and if they had obſerved, that the orbits of the greateſt of the former planets had leaſt eccentricity, they might from hence have concluded, that the earth's orbit having leaſt eccentricity, muſt neceſſarily be the greateſt planet of the other three; and if they had but once thought of this, the magnitudes and diſtances of the planets had been diſcovered; and if that had been diſcovered, the diſcovery of the laws of motion muſt have been the conſequence.

But now from proportions that are moſt evident let us turn our eyes to others, from whence we may make diſcoveries, which if they have not the ſame certainty will yet appear highly probable: Thus as the moon's diameter [1800 miles] is to the earth's diameter, [14800 miles] ſo is the earth's diameter to 122,000 miles, being twice the ſun's viſible diameter; and therefore it is more than probable, that the ſun muſt have an atmoſphere equal to its viſible diameter as well as the earth; this atmoſphere being as neceſſary to give life to its flames as the earth's is to the creatures it was made for.

But here it will be objected, that this overthrows my third general law of motion; for then the ſun muſt carry Mercury round it in 44 days inſtead of 88, and ſo that law cannot be general.—I anſwer that this law is certainly general, and agrees as exactly with the ſun's viſible ſemidiameter* as it does with the ſemidiameters of the primary planets; and ſuppoſing that it does ſo only in appearance and not really, yet this objection is of no force: For if the ſun has really ſuch an inviſible atmoſphere, then it is moſt evident, that it muſt move upon its axis with eight times the force as the planets do; and if it moves upon its axis with eight times the force as the planets, as every thing makes a reſiſtance equal to the force that is upon it, it can carry Mercury round it but four times as ſwift; ſo that this muſt be the ſame with reſpect to half the ſun's, as their's is to their whole ſemidiameter's: I conclude, therefore, that the viſible ſemidiameter of the ſun is but equal to half his real ſemidiameter; and conſequently the ſemidiameter of his atmoſphere muſt be equal to his viſible ſemidiameter; and this is a further confirmation, that the earth muſt be ſo likewiſe.

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* Is not this likewiſe, peculiarly adapted to the contemplation of man?

But further; as the moon, the earth and the ſun, are in geometrical proportion, ſo muſt Mercury and the ſun have a third proportional to anſwer them, and what can this be but the ſemidiameter of this planetary ſyſtem; or that diſtance to which the ſun's action reaches from its body, before it is balanced by the action of the fixed ſtars? Say then, as Mercury's diameter [185 miles] is to the ſun's diameter, [122,000] ſo is the ſun's diameter to 80,000,000 of miles, which muſt be the ſemidiameter of this planetary ſyſtem; and conſequently, the ſun's ſingle influence reaches 17,000,000 of miles further than the orbit of Saturn, before it is overbalanced by the joint influence of all the fixed ſtars. Again; as Mercury, the ſun, and the ſemidiameter of this planetary ſyſtem are in proportion; ſo is the ſun, the ſemidiameter of the planetary ſyſtem, and the ſemidiameter of the ſyſtem of the fixed ſtars: Thus as 122,000 miles is to 80,000,000 of miles, ſo is 80,000,000 of miles to 50,000,000,000 of miles, which, very likely, is the diſtance of the fixed ſtars from the verge of the planetary ſyſtem; and if ſo, then the fixed ſtars themſelvs do move round the ſun in direct proportion after Saturn, according to the third general law of motion: For as the time of Saturn's periodical revolution (29, 45 years) is to its diſtance from the ſun (63,000,000 of miles) ſo is the annus magnus (25,920 years) to 50,000,000,000 of miles, the diſtance of the fixed ſtars from Saturn as before; ſo that very likely, this is not a preceſſion of the equinoctial points, but a real motion of the fixed ſtars; and if it be, then it is evident, that the ſun is vaſtly greater than any of the ſtars, and is not only in the center of the planetary ſyſtem, but even in the center of the univerſe, where it ſhines with diſtinguiſhed glory. *What then becomes of the hypotheſis of our ſyſtem-mongers and world makers? ——It falls to pieces, and the moſaical creation appears to be univerſal.* But be this as it will, from what I have ſaid it is evident, that the earth is the glory of this ſolar ſyſtem: It is ſituated ſo as to have a clear view of all the planets and fixed ſtars; while, very probably, neither Mercury, Venus nor Mars can be ſeen from Jupiter, or Saturn. It appears to Venus almoſt as big as our moon does to us, and to Mars and Mercury it may well ſupply the want of a moon. To Jupiter and Saturn it may, very likely, be ſeen in the neighbourhood of the ſun continually; nay, even to the fixed ſtars, before it ſuffered by the flood, it might have appeared with glory; as, undoubtedly, it ſhall again one day, when the eternal judge ſhall grace it with his preſence. It contains more matter than all the reſt of the planets put together, is the principal orb for whoſe ſervice the ſun itſelf was created, and, tho' doomed to deſtruction, ſhall be new modelled with greater glory, as the everlaſting throne of God and his Meſſiah.

WHAT pity is it then, that any by a falſe philoſophy have been led to queſtion great theological truths, viz. *The primitive dignity of man, and the glory to which the human nature is advanced by its union with the eternal world:* At length it appears, that there is not any habitable world, in the ſolar ſyſtem, that is any way comparable to the earth; nor any planet, in the univerſe, that deſerves to be mentioned along with it: As for the ſecundary planets, 'tis unreaſonable to think them habitable, ſeeing they never turn upon their axis's: Whether the reſt of the primary planets are inhabited, or not, no mortal can tell; if they are not, we ſee they are not without their uſe; perhaps Venus and Mercury may be deſigned by the Almighty, as faithful guardians, to prevent fiery exhalations from damaging this important globe; and perhaps the lucid bodies of all the reſt may ſerve to increaſe the ſun's light quite thro' its ſyſtem. However this may be, we have ſeen their juſt proportions one to another, and therefore cannot doubt but they ſerve to balance the univerſe, and were created juſt to ſuit their places, by him who made all things in *number, weight and meaſure.*

BUT

But with what ſurpriſing beauty do the ſeveral heavenly bodies appear in their motions, their diſtances, their forms and their magnitudes! The ſun, as the firſt eſtabliſhed cauſe of all motion, and all the planets move upon their axis's in perfect uniformity: The firſt planet and firſt ſatellites (and probably the fixed ſtars) in their orbits follow one rule, and all the reſt follow them by one general law; the orbits, ſtill, having equal inclination, and proportional eccentricity, where the planets are proportional.

The planets, and their ſatellites, are all placed at ſuch proper diſtances, in the univerſe, that the motion of one can no way interfere with, or hinder, the motion of another.

As to form, the leſſer planets ſeem to be the greater in miniature; thus has Jupiter, the mean of the three greater planets, his belts, ſo has Mars, the mean of the three leſſer; nor do I at all doubt but Venus is a fair copy of our earth, and Mercury of Saturn.* And then, as to their magnitudes, as far as we have ſeen, they are all conſtituted acaccording to the rules of the moſt exact geometry; nor can we at all doubt but the reſt are as proportionable one to another. Thus future diſcoveries may ſatisfy us, that as Jupiter's firſt ſatelles is to Jupiter, ſo is Jupiter to the ſun; and no doubt but the reſt of the circumjovials are in proportion to that and one another; nay, I don't at all queſtion but every ſtar in the heavens is in the ſame geometrical proportion continued to the eternal wonder of all the angelical beings. Thus the viſible world is not indeed ſo big as it was thought; but it appears with ten thouſand times more beauty; and the moſt high God appears ſo plain in his amazing works, that any one who takes a view of the whole, cannot but ſay with holy Job.——*I have heard of thee by the hearing of the ear, but now mine eyes ſee thee.*

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* On this account I ſhall not at all be ſurprized, if only the three planets in proportion are found to revolve upon their

HAVING thus ſhewed the true diſtances and magnitudes of the planets, and theſe appearing to be much leſs than they were formerly thought, it is evident, that the magnitudes of the Comets muſt be reduced proportionably; ſo that it is not at all probable, that the biggeſt of them can exceed 40 miles diameter; and conſidering the very little denſity they can have, as being no more than a fiery vapour, it is impoſſible, that they ſhould ſo much as diſturb the earth [or even Mercury, the leaſt of all the plaplanets] in its motion; much leſs then can they preſs the earth, or any other of the celeſtial orbs into their ſervice. To be ſure they muſt conſume at a vaſt rate, and very probably their ſubſtance is quite exhauſted long before they reach the region of Jupiter: What then is become of all the imaginary fears of our virtuoſi!—Like the Comets they are vaniſhed, and have left nothing but a ſmoke behind them.

Yet it muſt be allowed, that a Comet, as an executioner of divine vengeance, may be made uſe of by the moſt High to poiſon the air with its noxious vapours, or even to burn up a country. To the Almighty nothing is fortuitous, and he may fire off theſe bolts of vengeance when, and wherever he pleaſes: Perhaps he made uſe of one to deſtroy Sodom, Gomorrah and the cities of the plain: But however this were, the ſight of them ought to call a ſinful word to repentance, as they are dreadful omens of a final diſſolution: For certainly, according to this account of them, the ſun muſt waſte conſiderably; ſo that experience, as well as ſcripture, may ſatisfy us, that the *world waxes old like a garment.* It was never intended, that it ſhould laſt always; nevertheleſs we know that the ſun is a prodigious body, and therefore its ſubſtance cannot ſoon be exhauſted; and ſuppoſe it might be conſumed in a million of years, yet if the world is not continued 10,000, it can never ſuffer by its conſumption.

To conclude,—from what I have ſaid it plainly appears, that the flood is not truly accounted for, neither by Sir *Iſaac Newton,* nor *Mr. Whiſton*; no Comet could occaſion it, nor can any ſuch ſhock be the cauſe of the general conflagration: Indeed, in what manner God will put an end to the preſent ſtate of things, is a ſecret that no mortal can find out; the ſame *eternal fiat* that once ſaid to the ſun, exiſt, may again ſay, *be ſcattered thro' all the planetary regions.*——Then ſwift as its rays would that conſuming fire itſelf approach all places, the heavenly bodies would be conſumed by what give life and ſupport to them, and the elements would melt with fervent heat.——*But we look for a new Heaven, and a new earth, wherein dwells righteouſneſs:* And in the interim, he is faithful who has promiſed, *That while the earth remains, ſeed time and harveſt, ſummer and winter, day and night ſhall not ceaſe.*

* * *

END OF THE THEORIES.

DEBATES:

ON THIS

New THEORY,

OF

COMETS, &c.

WITH THE

AUTHOR'S ANSWER:

TILL AT LAST

It ſtands confirmed beyond all Contradiction.

LIVERPOOL:
PRINTED for the AUTHOR, by T. COWBURNE,

MDCCLXVIII.

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OBJECTIONS
TO THE
AUTHOR'S THEORY OF COMETS.

Extract of a Letter from William Lerpinerie, Eſq; *of* LONDON, *to the* Author.

SIR,

YOURS I received this morning, and read your Theory of Comets, &c. Let any one peruſe *Ariſtotle*, lib. I. meteor, c. 7. and they will find, you have adopted your doctrine, which has been ſo long confuted by *Seneca*, lib. 7. natural quæſt. c. 22. and by all Aſtronomers ſince the time of *Tycho Brache.* The immortal *Seneca* conſiders them as the eternal works of nature, heavenly bodies, or planets placed in another vortex from eternity.

Is it credible, that a coagulation or maſs, of the nature of our ſmoke, which is of a bituminous nature, could remain inflamed in the air ſo long as the

Comet of 1680? Unleſs Mr. *Woods*, you will clear up this ſyſtem, I believe every unprejudiced gentleman will agree with Sir *Iſaac Newton*, that Comets are compact, ſolid, fixed and durable bodies, a kind of planets which move in oblique orbits.

I am, Sir, yours &c.
Wm. LERPINERIE.

LONDON,
JUNE 5th, 1765.

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The AUTHOR to WM. LERPINERIE, Eſq;

SIR,

WHAT you aſſert concerning my having taken my Theory of Comets from *Ariſtotle*, every ingenious reader knows to be falſe; and therefore, that it has been anſwered by *Seneca*, and all the Aſtronomers ſince the time of *Tycho*, muſt be as falſe. *Kepler*, *Hevelus*, and many other moſt eminent Aſtronomers, ſince *Tycho*, were as far off *Seneca's* and Sir *Iſaac Newton's* opinion as I am; and as near *Ariſtotle's*; and yet no wiſe man ever thought they ſtole their Theories from him.——If either *Seneca*, or you, conſiders Comets as exiſting from eternity, you conſider them as an atheiſt, and he that approves of it can be no other.—Oblique orbits —is the worſt of nonſenſe.——*Quicquid in Buccam venerit effutit.*

I am, yours &c.
MICHAEL WOODS.

LONDON,
JULY 1ſt. 1765.

Extract of a Letter from Dr. Franklin *of* PHILADELPHIA *to the* Author.

SIR,

YOUR's I received this morning, wherein I ſee you have inſerted a New Theory of Comets. Your Theory, according to your own words there, is this, "They are ſolar meteors, or exhalations of the ſame nature with our ſmoke, which flying to a certain diſtance from the ſun, thicken [or draw together] to ſuch a maſs, that at laſt their own gravity forces them back into its blaze; where they no ſooner arrive but they take fire, and are violently thrown off in right lines through the univerſe, till their own flames have exhauſted their ſubſtance."

YOUR reaſons for this Theory are four. The firſt and fourth of theſe ſeem to bid faireſt for ſupporting your hypotheſis; were they true. The other two, without theſe may poſſibly be very little depended upon. And "Firſt, the Comets going off from the ſun in right lines, is a clear proof of this hypotheſis:—By all the obſervations that have ever yet been made, it appears plain, that they deſcribe a right line, in which they can never poſſibly return to the ſun any more."—Theſe are your own expreſſions.

Now, from the obſervation made upon the Comet of 1680, Nov. 4th.—Sir *Iſaac Newton* ſays, it did not deſcribe a right line. Trajectoria cometæ hujus bis ſecuit planum eclipticæ, et propterea non fuit rectilinea. P. M. p. 505. edit. 3.

"FOURTHLY," you ſay, "they [i. e. the Comets] have never been ſeen moving towards the ſun—and as they have never been ſeen approaching to the ſun, it is very reaſonable to conclude, that they never do approach it in any orbit whatſoever, but are fired off from it as before related."

BUT according to Sir *Iſaac Newton*'s ſcheme of the trajectory of the Comets of 1680, it was ſeen approaching to the ſun. From Nov. 4, till the 26th of the ſame month, [if not ſomething longer] it was continually approaching to the ſun. I. M. p. 506.

UNLESS Sir, you will be ſo good, as clearly to remove theſe difficulties, 'tis not impoſſible but it may ſtill be ſaid, Sir *Iſaac* had reaſon for aſſerting, I. "That the Bodies of Comets are ſolid, compact, fixed and durable, like thoſe of the planets. For, if they were nothing elſe but vapours or exhalations of the earth, of the ſun and of the Planets, this Comet" [of 1680] "in its tranſit thro' the neighbourhood of the ſun muſt have been immediately diſſipated." The body of that Comet being then, according to him a matter of 2000 times hotter than red-hot iron. Ibid. p. 508. 2. That the common hypotheſis, as you (one would think) with no great reſpect call it, cannot be true, viz. that Comets move in certain orbits round the ſun.

"Theoria, quæ motui tam inæquabili per maximam cœli partem proba reſponder, quæque eaſdem obſervat leges cum theoria planetarum, et cum accuratis obſervationibus aſtronomicis accurate congruit, non poteſt non eſſe vera." Ibid. p. 506.

Possibly, this may put you upon clearing up this matter to the ſatisfaction of others, as well as of

Your humble ſervant,

PHILADELPHIA,
April 14. 1766.

BENJ. FRANKLIN.

* * *

The Author's Anſwer.

THE above letter I received when I was in *London*, but at that time did not think proper to anſwer it, till I had publiſh'd this Theory.—In anſwer to which—I ſee Dr. *Franklin*, has, from Sir *Iſaac Newton*, objected againſt two reaſons which I have given for my Theory of Comets: It being therefore neceſſary that I ſhould defend myſelf againſt that great man, before I do it I muſt inform my readers, that I have the higheſt regard for his wonderful genius; when I behold him rectifying ancient hiſtory, diſcovering the manner of viſion, or the principles of nature, it fills my ſoul with the greateſt ſurprize, and I can compare no body with him but the immortal *Kepler*. Yet tho' I have this veneration for him, I love to ſee with my own eyes, and can by no means believe any thing meerly becauſe he has ſaid it; therefore I ſhall never ſubmit, without further proof, to be run down by his authority.

As the Comet of 1680 was the greateſt that has appeared in theſe laſt ages, perhaps remarks that were then made, may be moſt proper to put an end to this debate; ſeeing, therefore, that the objections of this gentleman are founded on obſervations of Sir *Iſaac Newton* relating to that Comet, I will here give an account of its orbit according to his principles.

On the ſuppoſition that a Comet moves in an elliptical orbit extreamly eccentrical, Sir *Iſaac Newton* has demonſtrated, That the periodical time of any Comet is to the periodical time of any planet, in a ſeſquiplicate proportion of their principal axis; and Dr. *Halley* has concluded from obſervations, That the period of the Comet of 1680 is about 575 years: Conſequently, according to theſe ingenious gentlemen, the tranſverſe diameter of this Comet's orbit is near 69 times greater than that of the orbis magnus, and the following figure* repreſents the ellipſis it deſcribes, ſave that it is not eccentrical enough.

Now I appeal to any body, ſkilled in theſe matters, whether it be poſſible by one, or many obſervations of this Comet, to find out the leaſt curvity, tho'

tho' taken by the beſt inſtrument in the world; and if it be not poſſible to do this (as I am ſure it is not) then we muſt conclude—That the Comet of 1680, according to Sir *Iſaac Newton's* own principles, moved ſo nearly in a right line, that it was not poſſible to diſcover wherein it deviated from it. But Sir *Iſaac Newton* ſays, That this Comet, in its trajectory, twice cut the plane of the ecliptic, and therefore it did not move in a right line.——According to Dr. *Halley* this Comet's orbit had 60° 56 inclination to the ecliptic, and yet came very near the earth's way on Nov. 11th that year; and conſequently, if it did cut the plane of the ecliptic, it muſt be in, or very near, its aphelion and perihelion: For to ſay that a Comet can move in an orbit that has 60° 56 inclination to the ecliptic, that it can come near the earth's way, and yet cut the ecliptic at a conſiderable diſtance from its aphelion, &c. is to aſſert a ſtaring contradiction. And therefore, ſeeing neither Sir *Iſaac Newton*, nor any other mortal, could poſſibly ever ſee this Comet in its nodes, nor diſcover wherein its courſe differed from a right line; I call upon Dr- *Franklin* or his friend the *Aſtronomer Royal* to give me a demonſtration of the method whereby Sir *Iſaac Newton* could, and moſt certainly did know this; and I'll promiſe him, I'll immediately become a convert to his opinion; but till he does this, my firſt reaſon for my hypotheſis ſtands unſhaken.

But then, what becomes of my fourth reaſon, ſeeing Sir *Iſaac Newton* has aſſerted, That from *Nov.* 4th to *Nov.* 26th (if not longer) this Comet was continually approaching to the ſun?—I muſt confeſs I never read the hiſtory of the Comet of 1680, and by the accounts of all the other Comets I could any way come at, I ſtill found they were ſeen in their journey from the ſun: Nor is there any ſtreſs to be laid on this obſervation of Sir *Iſaac Newton*'s to the contrary, ſeeing if he were any way miſtaken in the diſtance and velocity of this Comet, it is moſt evident that it might be coming from the ſun all the time that he thought it was moving towards it.

Thus let S be the ſun, and the circle A B C D E the earths orbit, the right line F G H I K the Comet's true trajectory, and the parabolic curve L M N O P the miſtaken trajectory of the Comet at a further diſtance: Then, I ſay, ſuppoſing the earth at A, and the Comet at F, yet by ſuch miſtake in the diſtance, the Comet will appear at L; and tho' while the earth proceeds from A to B, the Comet regularly aſcends from the ſun from F to G, yet by continuing the former error it will appear as if it moved towards the ſun from L to M; and according as the earth proceeds to C D and E, and the Comet to H I and K, the latter will appear as if it went on to N O and P. Thus we ſee how eaſy it is for the greateſt of men to be deceived in this matter, if we but admit of a miſtake in the Comets diſtance and velocity, and we have no reaſon to believe Sir *Iſaac Newton* to be right, unleſs we will yield to his ſeſquiplicate proportions, *i. e.* ſubmit that the Comets move in elliptical orbits vaſtly eccentrical, and without proof give up the point in debate.

Yet, ſuppoſing that the Comets of 1680 did really move towards the ſun from *Nov.* 4th to *Nov.* 20th, or *Dec.* 8th according to Dr. *Halley*, this by no means overthrows my hypotheſis. It does indeed prove, that this Comet thickened, and drew together at a greateſt diſtance from the ſun than I believe it could do, yet even from thence it might fall down directly from the ſun's body till the force of its flames ſent it back again; ſo that we ſee, he muſt either prove, that this Comet did make its tranſit over the ſun's body, or he does nothing.—But I need not put him to this trouble, ſince it appears ſo plain, that it might all this time be coming from the ſun; and that ſuppoſition agrees ſo exactly with my hypotheſis, by leſſening its velocity ſuitable to that of a vapour, which can never fly ſo ſwift as the worlds in their orbits. I conclude therefore, that the Comet of 1680 was not ſo diſtant, nor ſo big, nor ſo ſwift as it was thought to be; but was thrown off from the ſun in a right line that paſſed very near the plane of the ecliptic.

As to what he talks, from Sir *Iſaac Newton*, of the great heat this Comet muſt ſuſtain, which muſt immediately diſſipate it, if it was not a compact durable body.—I know of no other way of diſſipating ſolar vapours, but by firing them, and driving them away: And beſides as air is the fuel of fire, I don't ſee how the ſun can give any thing ſuch a roaſting where the Æther is ſo thin, as according to Sir *Iſaac Newton*'s ſcheme. I believe neither him, or ever a friend he has can prove, that the ſun itſelf is 2000 times hotter than redhot iron, and how the ſun can heat any thing hotter than itſelf is quite beyond my comprehenſion. I don't yet agree with Sir *Iſaac Newton*, that Comets are ſubject to the ſame laws with planets; and therefore think it very poſſible that his Theory may be falſe, and I think I have proved it ſo.

DR. *Franklin* ſays, my other two reaſons, for my Theory, without theſe which he has objected to, may poſſibly be very little depended upon.—But, as I have demonſtrated, that the motion of the planets in their orbits is dependant upon the ſun's motion upon its axis, I have ſo good an opinion of the third that I think it will do the buſineſs itſelf; and as to the ſecond, if he'll allow the truth of the old axiom, *Natura nihil agit fruſtra*, the bringing globes of fire to the ſun, looks but like carrying coals to *Wigan*.—But poſſibly, he might not be willing to engage, where he could not put Sir *Iſaac Newton* in the front; however, that he may ſee that I have not brought my whole force into the field, I here give him four more reaſons to pick and chuſe out of. And,

FIFTHLY, The phaſes, or manner in which Comets ſhew themſelves to us, is a clear proof of my hypotheſis: They don't, appear like the planets when viewed thro' a teleſcope. *Sturmius* ſays, that obſerving the Comet of 1680, it appeared like a coal dimly glowing; or like a rude maſs of matter illuminated with a duſky fum'd light. *Hevelius* ſays, that the Comet of 1661 was of a yellowiſh colour; bright, but its light ſtill more duſky than the reſt of the ſtars. *Weigelius*, who ſaw the Comet of 1664, the moon, and a little cloud illuminated by the ſun, at the ſame time, obſerved, that the Comet appeared like a cloud in the horizon, and not like the moon. All this agrees with my hypotheſis, but not all with that commonly received.

SIXTHLY, The Comets, have ever ſeemed to have a ſenſible decreaſe from their firſt appearance; whereas, if they were durable Bodies returning to the ſun, they ſhould appear as ſmall at firſt as at laſt. M. *de la Hire*, makes this objection againſt the return of Comets, and I inſiſt upon it as a clear proof that they are a meer vapour, according to my hypotheſis; for tho' it may be poſſible, that a Comet may ſeem to increaſe a little, if the earth's approach towards it increaſes its apparent diameter faſter than its conſumption waſtes its body; yet it is very plain, as it very faſt diminiſhes, it muſt appear biggeſt (or very near biggeſt) at firſt, which is known to be always the caſe.

Seventhly, The tails of Comets being ſometimes ſeen without their heads is a clear proof of my hypotheſis. The tail of a Comet was ſeen at *Rome* in the year 1702, according to M. *Caſſini*; and *Hevelius* ſays, when he ſaw the Comet of 1661, on *March* 28th, its body was very pale, and exceeding thin, no diſtinct nucleus at all appearing.—Here then is two inſtances, viz. The one of a Comet juſt burnt out; the other of a Comet quite exhauſted, nothing being left but the ſmoke; which to be ſure muſt appear ſome time after the body is conſumed.

Eightly, The tail of Comets appearing more large and bright, ſtrong and vivid, when they are firſt ſeen in the neighbourhood of the ſun, is a clear proof of my hypotheſis; for ſurely the longer any thing burns, after it has been thoroughly lighted the more it muſt be weakened, and the more languid it muſt appear.

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I think I have ſaid enough to eſtabliſh my Theory of Comets; and likewiſe ſhewed the abſurd opinion of Sir *Iſaac Newton* upon this ſubject; ſo that, this Theory ſtands confirmed beyond all contradiction.

60.

FINIS.